The Zoological Society of Japan

ANNOTATIONES ZOOLOGICAE JAPONENSES
Volume 56, No. 4—December 1983

Published by the Zoological Society of Japan

The Faunal Affinity of the Island of Awaji-shima as Viewed from Trechine Beetles

With 4 Text-figures

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ABSTRACT Two new upper hypogean species of the trechine genus *Trechiama* are described under the names of *T. tenuis* and *T. onocoro*, the former from the eastern part of the Sanuki Hills in northeastern Shikoku and the latter from the southern part of the Island of Awaji-shima. Both belong to the *satoui* complex of the group of *T. oni*. A close affinity of southern Awaji-shima to northeastern Shikoku as viewed from anophthalmic trechines is definitely proved by the discovery of these new species.

INTRODUCTION AND GENERAL REMARKS

Awaji-shima is one of the larger accessory islands of Japan, lying at the eastern end of the Inland Sea of Seto-naikai between the eastern part of western Honshu and northeastern Shikoku. It is 593 km^2 in area, but attains only to 608 m in altitude even at the highest point. Administratively, it belongs to Hyôgo Prefecture in western Honshu, but the hilly area in its southern part, called the Yuzuruha Hills, is nearer, both geographically and topographically, to the Sanuki Hills of northeastern Shikoku towards the west and to the Izumi Hills of the Kii Peninsula towards the east. The faunal affinity of the island as viewed from anophthalmic trechines has long been a matter of our concern, since the mainland part of Hyôgo Prefecture opposite to Awaji-shima and the northeastern part of Shikoku have been known to harbour different lineages of the group of *Trechiama oni*. The former area is at the southern periphery of the distributional range of the *kosugei* complex (cf. UÉNO, 1983 c), while the Sanuki Hills in the latter are inhabited by the members of the *satoui* complex (cf. UÉNO, 1975, 1983 a). These complexes are not directly related to each other, being situated at the opposite positions within the species-group.

However, it was not easy to find out certain anophthalmic trechines on the Island of Awaji-shima, because of the lack of cavities of moderate size, both natural

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and artificial, with the exception of a small limestone cave lying near the northern tip. It was the knowledge about the upper hypogean fauna that led to the discovery of an anophthalmic *Trechiama* on the southern hills of the island. Early in the winter of 1982, Messrs. Yoshiaki NISHIKAWA and Akira NOTO at last succeeded in digging out a female specimen of an anophthalmic trechine beetle from a colluvium in the Ayuya-gawa Valley. They revisited the locality in the next spring, and obtained an ampler material, including males, of the same species. A careful examination of this collection enabled me to ascertain that the trechine was a new species closely related to *Trechiama satoui* S. UÉNO, an anophthalmic species distributed to the western part of the Sanuki Hills and also known from an isolated hill in Takamatsu City.

In the meantime, another close relative of *T. satoui* was obtained by Mr. Masaaki SATOU at the eastern part of the Sanuki Hills. This is also an upper hypogean trechine, and though apparently closer to *T. satoui* than to the Awaji-shima species, it is more distinctive in external morphology than the latter. At any rate, this species neatly fits in the blank in the distributional range of the *satoui* complex of *Trechiama*.

Thus, we have now gained a fairly good knowledge about the distribution of the *satoui* complex. The five species hitherto known are dispersed at the northern side of the Median Tectonic Zone in northeastern Shikoku and southern Awaji-shima. Of these, the two western species, *T. fujiwaraorum* S. UÉNO and *T. instabilis* S. UÉNO, are rather isolated respectively from the taxonomic view-point (cf. UÉNO, 1981), whereas the remaining three form a superspecies within the *satoui* complex. Here, it should be noted that the southern side of the Median Tectonic Zone in eastern Shikoku is occupied by the members of the group of *Trechiama chikaichii*, which is radically different from the *satoui* complex under consideration (cf. UÉNO, 1957, pp. 179–184, 1975, pp. 207–210, 1983 b, d).

What is most important and interesting is that the Island of Awaji-shima, at least its southern part, harbours an anophthalmic trechine, which is very closely allied to the species distributed to the Sanuki Hills and utterly different from those occurring in the eastern mainland part of Hyôgo Prefecture. This probably means that the Yuzuruha Hills of southern Awaji-shima were the eastern continuation of the Sanukis until rather recently, that the dispersal of the ancestral trechines was effected mainly along the ancient range, and that the subsequent separation of that old range caused isolation of original populations and eventually resulted in the speciation of the ancestral beetle. It is to be seen if the eastward dispersal of the ancestral trechines extended further east onto the easternmost part of the ancient range, now recognized as the Izumi Hills, and left its evidence there.

DESCRIPTIONS

In the following descriptions of the two new species, the same abbreviations

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as those explained in my 1975 paper are employed throughout.

Trechiama (s. str.) ***tenuis*** S. UÉNO, sp. nov.

[Japanese name: Shirotori-mekura-chibigomimushi]

(Figs. 1–2)

Length: 5.30–5.70 mm (from apical margin of clypeus to apices of elytra).

Closely allied to *T. satoui* S. UÉNO (1975, p. 204, figs. 1–3, 1983 a, p. 74), but externally different from that species in the shape of elytra, which are longer, relatively narrow and less convex, and the conformation of scutellar striole, which is longer and deeply impressed throughout. Readily distinguished from *T. satoui* by the shape of male genitalia, especially of aedeagal apical lobe which is much more slender and ventrally curved, and the shorter teeth-patch at the left side of inner sac.

Colour as in *T. satoui* though somewhat darker. Head and prothorax similar in every detail to those of *T. satoui*; PW/HW 1.38–1.48 (M 1.44), PW/PL 1.02–1.09 (M 1.05), PW/PA 1.43–1.51 (M 1.48), PW/PB 1.35–1.46 (M 1.40), PB/PA 1.04–1.10 (M 1.06). Elytra relatively narrow, longer and less convex than in *T. satoui*, usually widest a little before the middle, and more regularly narrowed towards apices than towards bases; EW/PW 1.65–1.77 (M 1.70), EL/EW 1.54–1.62 (M 1.59); shoulders distinct though rounded, prehumeral borders slightly arcuate and usually a little more oblique than in *T. satoui*; sides less arcuate at middle and more narrowly rounded at apices than in *T. satoui*, with the lateral borders rather narrowly reflexed; striae as in *T. satoui* though somewhat shallower at the side; scutellar striole longer than in *T. satoui* and deeply impressed, apical striole more regularly, though weakly, curved. Legs as in *T. satoui* though somewhat thinner.

Male genital organ generally similar to that of *T. satoui*, equally small and heavily sclerotized, but evidently different in the conformation of apical lobe and some other details. Aedeagus about three-tenths as long as elytra, elongate, much flattened in apical half, and gradually tapered from before middle in lateral view; basal part elongate, more strongly bent towards the ventral side than in *T. satoui*, angulately emarginate at the sides of basal orifice, and provided with a fairly large sagittal aileron; apical lobe much longer and narrower than in *T. satoui*, parallel-sided in apical two-thirds and blunt at the extremity in dorsal view, exceedingly narrow, curved ventrad, and distinctly turned up at the tip in lateral view; in profile, ventral margin almost straight at middle but widely emarginate before apex. Inner armature as in *T. satoui*, but the left proximal teeth-patch is much shorter due to shorter anterior arms. Styles relatively elongate, each usually bearing four apical setae which are fairly long; a short extra seta sometimes present on one of the styles.

Type-series. Holotype: ♂, 4–XI–1982, S. UÉNO leg. Allotype: ♀, 4–XI–1982, M. SATOU leg. Paratypes: 3♂♂, 2♀♀, 31–X–1982, M. SATOU leg. All deposited in the collection of the Department of Zoology, National Science Museum

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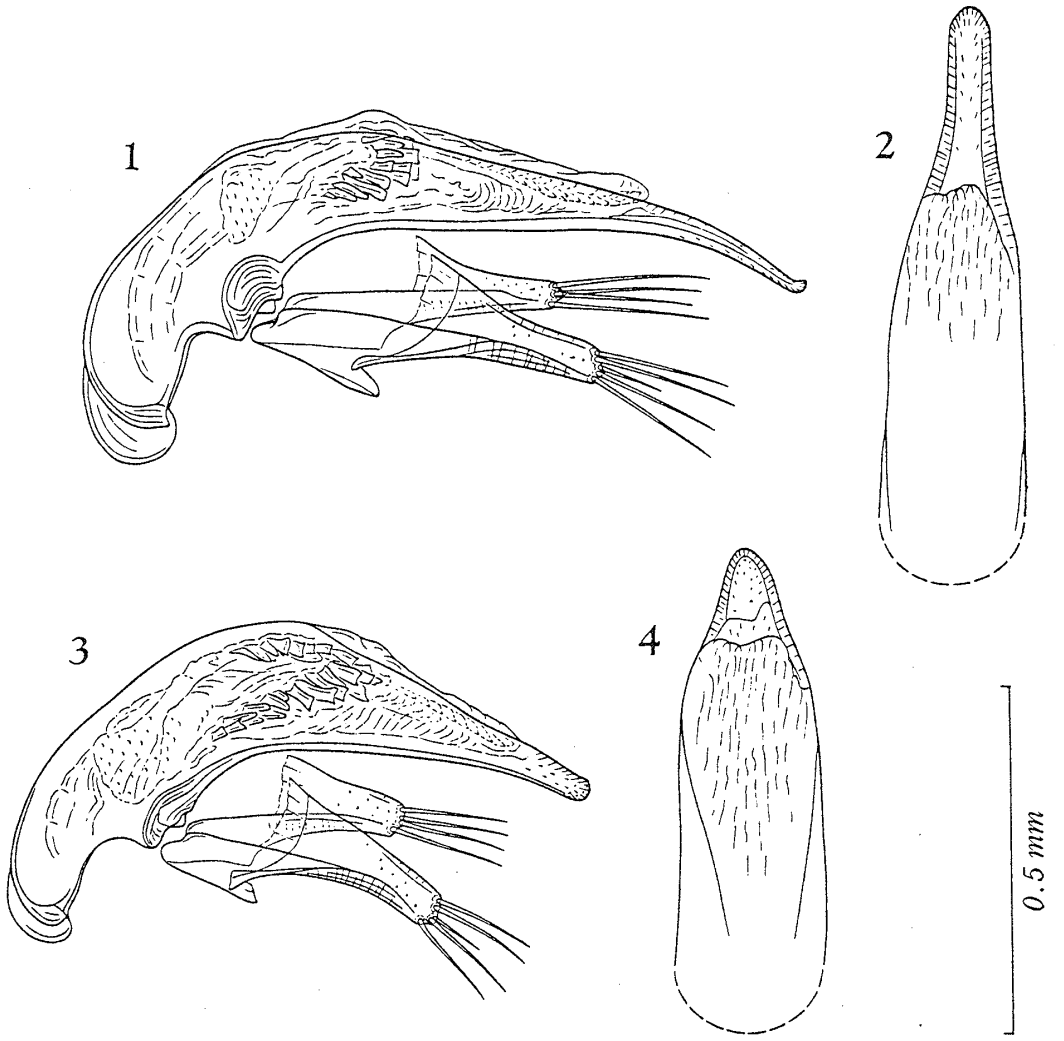

Figs. 1–4. Male genitalia of *Trechiama* spp. of the *satoui* complex; left lateral view (1, 3), and apical part of aedeagus, dorso-apical view (2, 4). —— 1–2. *T.* (s. str.) *tenuis* S. UÉNO, sp. nov., from Mitsu-ga-maru of the Sanuki Hills. —— 3–4. *T.* (s. str.) *onocoro* S. UÉNO, sp. nov., from Kabuto-yama of the Yuzuruha Hills on the Island of Awaji-shima.

(Nat. Hist.), Tokyo.

Type-locality. Mitsu-ga-maru, 230 m in altitude on the N slope, in Shirotori-chô of Kagawa Prefecture, northeastern Shikoku, Southwest Japan.

Notes. This trechine might be considered an extreme geographical race of *T. satoui* isolated at the eastern part of the Sanuki Hills. As will be shown in later pages, however, the Awaji-shima form is identical with *T. satoui* in external morphology, and yet its differentiation doubtless attains to the species level. Since the Mitsu-ga-maru form is readily recognized on its external features alone and since its male genitalia are considerably modified, I prefer to regard it as a full species unless certain contradictory evidence is gained by future investigations.

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The type material of this new species was taken in the small shaded valley called Nishitani-gawa flowing down the northern slope of the head called Mitsu-ga-maru (611 m in height), which is about 21 km east-northeast of Ôyashiki, the eastern-most known locality of *T. satoui*. Several erosion control dams had been constructed across the valley, though all of them were already filled up to the brims with rock debris and soil. The stream sank under the deposit, appearing on the surface only on rainy days. Under one of the dams was formed a kind of thick colluvium, in which lived the *Trechiama*. All the known specimens were found at the depth of 50 cm or more, usually from under large stones buried in the soil.

Trechiama (s. str.) ***onocoro*** S. UÉNO, sp. nov.

[Japanese name: Onokoro-mekura-chibigomimushi]

(Figs. 3–4)

Length: 5.25–5.95 mm (from apical margin of clypeus to apices of elytra).

Externally very similar to *T. satoui* and practically indistinguishable from the latter species, but the male genitalia are evidently smaller and shorter, bearing short broad apical lobe and very large teeth-patch at the left side of inner sac. The standard ratios are as follows: PW/HW 1.42–1.50 (M 1.46), PW/PL 1.06–1.14 (M 1.10), PW/PA 1.44–1.53 (M 1.48), PW/PB 1.35–1.50 (M 1.43), PB/PA 0.99–1.10 (M 1.04), EW/PW 1.71–1.81 (M 1.77), EL/EW 1.45–1.52 (M 1.49).

Male genital organ similar in general structure to that of *T. satoui*, but obviously smaller and shorter, lightly sclerotized, with the apical lobe much shorter and broader. Aedeagus only one-fourth as long as elytra, moderately arcuate and somewhat flattened, with rather small basal part hardly bent ventrad; basal orifice fairly large, with the sides deeply emarginate; sagittal aileron hyaline, not particularly large though distinct; viewed laterally, apical part gradually narrowed towards apex, which is blunt, fairly thick, and very slightly turned dorsad; viewed dorsally, apical lobe short and broad, rather abruptly narrowed from behind apical orifice, and narrowly rounded at the extremity; ventral margin almost straight behind middle in profile, except for apical lobe which is slightly curved ventrad. Inner sac armed with two patches of sclerotized teeth but devoid of differentiated copulatory piece; left proximal teeth-patch much larger than in *T. satoui* though likewise horseshoe-shaped, consisting of very large, heavily sclerotized teeth and lying at about middle of aedeagus; right apical teeth-patch composed of much smaller teeth lying just inside apical orifice. Styles short and broad, left style being much larger than the right, each usually bearing four short setae at apex, though a short extra seta sometimes occurs on one of the styles.

Mature larva. Length: 7.7 mm (from the apex of clypeal lobe to the tip of anal tube).

Almost identical with that of *T. perissus* S. UÉNO (1983 d, p. 135); I was unable to detect any specific characters to distinguish it from the latter.

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Type-series. Holotype: ♂, allotype: ♀, Ayuya-gawa Valley, 26–III–1983, Y. NISHIKAWA leg. Paratypes: 1 ♀, Ayuya-gawa Valley, 4–XII–1982, Y. NISHIKAWA & A. NOTO leg.; 5 ♂♂, 2 ♀♀, 1 mature larva, Ayuya-gawa Valley, 26–III–1983, Y. NISHIKAWA leg.; 2 ♂♂, Nariai-gawa Valley, 26–III–1983, Y. NISHIKAWA & A. NOTO leg. All deposited in the collection of the Department of Zoology, National Science Museum (Nat. Hist.), Tokyo.

Type-locality. Kabuto-yama, ESE foot in the Ayuya-gawa Valley 205–220 m in altitude (in Sumoto-shi) and S foot in the Nariai-gawa Valley 210 m in altitude (in Mihara-chô), on the Island of Awaji-shima in Hyôgo Prefecture, Southwest Japan.

Notes. Though indistinguishable from *T. satoui* by external characters, this trechine is specifically distinctive from the Shikoku species beyond all reasonable doubt, seeing that the male genitalia show another trend of differentiation. Its aedeagal apical lobe remains unmodified, making a sharp contrast with the narrowly prolonged one in *T. satoui*, whereas the left proximal teeth-patch inside its inner sac is markedly developed though it maintains the same basic pattern as that of the latter. It seems highly probable that *T. onocoro* is the species first isolated from the other members of the superspecies *satoui*. This may be why it retains the ancestral type of the median lobe, though its inner armature has undergone a considerable development in isolation.

This interesting new species has so far been known only from the two stations on either side of Kabuto-yama (526 m in height), which lies at the central part of the Yuzuruha Hills stretching from west-southwest to east-northeast along the southern end of the Island of Awaji-shima. The hill is about 47 km distant to the east by north beyond the Naruto Straits from Mitsu-ga-maru, the type-locality of *T. tenuis*. It is rather sparsely vegetated and does not appear to be particularly good for harbouring anophthalmic trechines. Most of the known specimens, including the mature larva, of *T. onocoro* were taken near the headspring of the western branch of the Ayuya-gawa Valley at the east-southeastern foot of Kabuto-yama. They were invariably found in the colluvia at the right side of the stream, usually at the depth of 30 cm or more but sometimes from shallower spots. Two of the paratypes were found in the Nariai-gawa Valley at the southern foot of the same hill, about 2.7 km distant to the south-southwest in a bee-line from the Ayuya-gawa station. They were dug out from a colluvium accumulated in a small side gully.

The specific name *onocoro* is derived from Onokoro-jima, an old name of the Island of Awaji-shima.

ACKNOWLEDGEMENT

I am deeply indebted to Messrs. Yoshiaki NISHIKAWA, Akira NOTO, Masaaki SATOU and Masahiro IWASAKI, who not only placed their findings at my disposal

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for study but also aided my investigations in the field.

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